
खट्टे फल — भंडारण के लिए दिशानिर्देश

(पहला पुनरीक्षण)

Citrus Fruits — Guidelines
for Storage

(First Revision)

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FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Fruits, Vegetables and Allied Products Sectional Committee had been approved by the Food and Agriculture Division Council.

IS 7192 was first published in 1974, for which assistance had been drawn from the then ISO Draft International Standard on the subject.

This first revision of the standard is based on ISO 3631 : 2019 ‘Citrus fruits — Guidelines for storage’. While adopting provisions of ISO 3631 : 2019, changes have been made in the standard after deletion/addition of the text in ISO 3631 : 2019 in order to make the standard relevant in Indian context. The variations from the ISO 3631 : 2019 are tabulated in Annex D. The list of documents referred while preparing this standard are included in Bibliography in Annex E. Thus, this Indian Standard is a modified version of ISO 3631 : 2019 ‘Citrus fruits — Guidelines for storage’.

In this revision, following additions have been made from the previous version:

- a) Scope extends to the two more varieties of citrus fruits, that is, lemons: *Citrus limon* (Linnaeus) and grapefruits: *Citrus paradisi*;
- b) A new sub clause ‘keeping life’ has been added under the clause ‘storage conditions’ giving refrigerated storage temperatures for a range of citrus fruits varieties produced in different countries of the world; and
- c) Annex A (Varieties of citrus fruits intended for storage) Annex B (List of principal commercial cultivars and producing countries) and Annex C (Damage to citrus fruit during storage) have been added, for information.

The composition of the Committee responsible for formulation of the standard is given in Annex F.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (revised)’.

Indian Standard

CITRUS FRUITS — GUIDELINES FOR STORAGE

(First Revision)

1 SCOPE

This standard specifies the conditions required for good keeping of the following groups of citrus fruits during their storage with or without refrigeration, in stores or in various transport vehicle or transport system (such as containers, railway cars, trucks or ships):

- a) oranges: *Citrus sinensis* (Linnaeus) Osbeck;
- b) mandarins: *Citrus reticulata* Blanco;
- c) lemons: *Citrus limon* (Linnaeus) N. L. Burman;
- d) grapefruits: *Citrus paradisi* Macfadyen;
- e) limes:f) *Citrus aurantifolia* (Christmann) Swingle; and
- g) *Citrus latifolia* Tanaka.

Detailed information concerning cultivars in these different groups is given in Annexes A and B.

2 REFERENCES

The following Indian Standards contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

| IS No. | Title |
|-------------------------------------|---|
| 7252 : 2013/ ISO 2169 : 1981 | Fruits and vegetables — Physical conditions in cold stores — Definitions and measurement (<i>first revision</i>) |
| 13815 : 2010/ ISO 2173 : 2003 | Fruit and vegetable products — Determination of soluble solids content — Refractometric method (<i>first revision</i>) |
| 13844 : 2003/ ISO 750 : 1998 | Fruit and vegetable products— Determination of titratable acidity (<i>first revision</i>) |

3 CONDITIONS OF HARVESTING AND PUTTING INTO STORE

3.1 Varieties (Cultivars)

This standard concerns fresh fruit intended for storage and belonging to the varieties listed in Annex A.

3.2 Harvesting

The fruits should be harvested when they have reached the stage of maturity that makes them fit for consumption. Harvesting may be temporarily interrupted when weather conditions (rain, etc) are likely to have an adverse influence on the keeping qualities.

Fruit collected from the ground is often infected with *Phytophthora*, and therefore dropped fruit should not be harvested.

The maturity criteria usually considered are the following:

- a) juice content, expressed as a percentage by mass (the juice content may vary slightly as a result of the weather conditions and delayed harvesting);
- b) flavour; and
- c) titrable acid (TA) and/or the TSS/TA ratio, which is calculated by the formula $\frac{x}{y}$

where

x is the total soluble solids content (see IS 13815 : 2010/ISO 2173 : 2003); and

y is the acidity expressed as an hydrous citric acid (see IS 13844:2003/ISO 750 : 1998).

The values to be adopted for these last two criteria depend on the varieties under consideration, and on ecological conditions. They should therefore be considered only in relation to the variety and to a well-defined area of production. Reference should be made to the specialized documents that have been published on the subject in the different areas of production.

3.3 Quality Characteristics for Storage

3.3.1 Condition of Fruit at Harvesting

Fruits intended for storage should be clean, firm and without blemishes (damage caused by pickers' fingernails, insect punctures, bruises, etc). There should be no evidence of fungal or physiological disorders. They should retain their calyces.

Ethylene degreening is not advisable for fruit intended for long storage. This treatment hastens the physiological development of the fruit and shortens its keeping life. If it has been carried out, this fact should be brought to the attention of prospective purchasers. Ethylene-degreened fruit may be packed without stem-ends.

3.3.2 Treatment of Fruit

3.3.2.1 After a first sorting in order to remove leaves, trash and defective fruits (such as those that are damaged or heavily infected with *Penicillium*), the fruits are preferably washed by spraying (which reduces the risk of infection) or by sprinkling or soaking in tanks. They are then rinsed and brushed and receive a fungicidal treatment. This should be applied as soon as possible after harvesting. For fruit picked with a high degree of turgidity, treatment should be delayed for 24 h after picking. Lemons and limes are not always washed.

The fungicidal treatment is carried out with a solution or a suspension of a fungicidal product and, in the case of infection by *Phytophthora*, can include a heat treatment carried out by dipping the fruit in a treating solution or water for 1,5 min to 5 min, at a temperature varying between 35 °C and 48 °C. This treatment is effective when carried out shortly after rains and infection in the grove.

Fungicidal treatments are applied as applicable. They should not leave visible deposits on the fruits.

The fungicidal treatment is generally followed by rinsing in order to ensure that the fungicide residues after treatment do not exceed the limits authorized.

A certain period of exposure to air before washing and fungicidal treatment renders the skins less turgid and less subject to bruising, which may arise during subsequent handling. As any bruising may lead to rotting, this procedure should only be followed in the case of fruit from areas of production in a dry climate. As a general rule, this period should not exceed 24 h.

3.3.2.2 After treatment, the fruit can be covered with a wax in order to replace the natural coating of the fruits which is partly or entirely removed by washing and brushing. By way of an example, emulsions of carnauba wax, beeswax, extracted or paraffin waxes, and polyethylene based wax may be used for this purpose. An approved fungicide may be incorporated into the wax (for example, orthophenylphenol, benzimidazol).

The amount of wax can be increased if long storage is contemplated (up to 140 mg per kilogram of fruit is permitted).

A second sorting is usually carried out after treatment and is followed by size grading. These operations should be carried out very carefully to avoid damage to the skin of the fruit.

3.3.2.3 It is advisable that information on the surface treatment used be made available to prospective purchasers.

3.4 Putting into Store

Citrus fruits should be put into store immediately following the end of the treatment of the fruits.

The fruits can be stored unwrapped or wrapped in tissue paper (wraps which may be impregnated with diphenyl). Wrapping prevents damaged fruits from spreading contamination to neighbouring fruits and diminishes loss of mass of fruits during transport and storage. Papers impregnated with fungicide can be replaced by porous substrates impregnated with fungicides that are placed between the layers of fruit.

Fruit is placed (in layers or loose) in wooden, plastics or large metal frame and wire containers, or in corrugated cardboard cartons. The fruits should be pressed lightly together in order to prevent movement (after it has settled) during transport, but not so tightly as to cause bruising. The lids should press lightly on the fruit, without causing damage. The boxes should be handled with care.

For information on damage to citrus fruit during storage, see Annex C.

4 STORAGE CONDITIONS

4.1 Storage without Refrigeration

Good quality fresh fruit can be stored immediately after harvesting at the place of production in well-ventilated premises at temperatures varying between 10 °C and 18 °C.

4.2 Refrigerated Storage

4.2.1 General

For definitions and measurement of the physical quantities affecting storage, see IS 7252 : 2013/ISO 2169 : 1981.

Refrigerated storage can be carried out with or without pre-cooling.

4.2.2 Pre-cooling

Pre-cooling should be applied when the fruit is to be kept for long periods and final temperature should be reached within a maximum of 6 to 8 h.

The following conditions should be applied:

- the pre-cooling temperature adopted is that for keeping;
- air velocity : 200-400 mts/minute; and
- relative humidity: to be kept as high as possible (of the order of 90 percent).

4.2.3 Short, Medium and Long-term Refrigerated Storage

4.2.3.1 Temperature

The storage temperature depends, among other factors, on the species and variety of the fruit, the area of production, the physiological condition, the degree of ripeness and the anticipated length of keeping. Table 1 gives, for information, the temperatures according to varieties and areas of production.

Some species of fruit have a temperature limit for long keeping below which deterioration of the fruit occurs. However, if a short-term storage is only being contemplated, the limiting temperature or even one somewhat lower may be used in order to reduce the risks of fungal damage. For example, grapefruit may be kept at 9 °C to 10 °C for 4 to 6 weeks, or at 5 °C to 6 °C for 4 to 6 weeks for grapefruits late in the season. For varieties which are relatively unaffected by cold, a treatment of 10 to 12 days at 0 °C may be applied in order to kill the fruit flies in fruit that is already infested.

4.2.3.2 Relative humidity

The relative humidity should be maintained between 85 percent and 95 percent throughout the storage period.

4.2.3.3 Air circulation

An air-circulation ratio of 25 to 50 is maintained throughout the storage period.

4.2.3.4 Fresh air change

Fresh air change should be continuous, at a rate of once or twice per hour according to the storage temperature, in order to prevent accumulation of carbon dioxide (of the order of 0.2 percent to 1.0 percent).

4.3 Keeping Life

The keeping life depends on several factors, such as variety, ecological and phytosanitary conditions, date of harvesting, damage from harvesting or resulting from handling, treatment at harvesting, care in handling, and keeping temperature. Examples of periods of keeping are given in Table 1, which are likely to vary considerably.

Table 1 Refrigerated Storage Temperatures

(Clauses 4.2.3.1 and 4.3)

| Cultivars | Country of Production | Refrigerated Storage | | | | | |
|-------------------|-----------------------|----------------------|---------------------|----------------|----------------|------------------------|----------------|
| | | Short-term | | Medium-term | | Long-term | |
| | | Temperature °C | Weeks Expected | Temperature °C | Weeks Expected | Temperature °C | Weeks Expected |
| Oranges | | | | | | | |
| Camargo | Brazil | | | | | +2 | 12 |
| | Rep. of South Africa | | | | | +4 | 10 |
| Valencia late | Rep. of South Africa | | | | | +4,5 | 10 to 14 |
| | Australia | | | | | +2,5 to +7 | 10 to 14 |
| | USA (California) | | | | | +2 to +7 | 6 to 8 |
| | Spain | +10 to +12 | 4 | +8 to +10 | 8 | +2 | 14 to 16 |
| | USA (Florida) | | | | | -1 to +1 | 8 to 12 |
| | Israel | +2 to +10 | 6 | +2 to +4 | 6 to 10 | +2 | 10 to 14 |
| | Morocco | +4 to +6 | 4 | +2 to +4 | | +2 to +3 | 8 |
| | USA (Texas) | | | | | 0 | |
| | West Indies | | | | | + 7 | |
| Mossambi | India | +15 to +18 | 3 6 ^a | | | +6 to +8 | 12 to 16 |
| Navel | Spain | +10 to +12 | 2 | +6 to +10 | 6 | +2 to +3 | 10 to 12 |
| | Morocco | +6 | 4 | +4 | 6 | +3 | 8 |
| Castellana | Spain | | | | | +1 | 10 to 12 |
| Salustiana | Spain | +10 to +12 | 2 | +6 to +10 | 6 | +2 | 16 |
| Shamouti | Israel, Lebanon | +4 to +15 | 4 | +4 to +8 | 4 to 6 | +4 to +5 | 6 to 8 |
| Verna | Spain | +10 to +12 | 4 | +6 to +10 | 8 | +2 | 14 to 16 |
| Washington, Navel | Australia | | | | | Early: +4,5 to +5,5 | |
| | | | | | | Late: +4,5 to +7 | |

Table 1 (Continued)

| Cultivars | Country of Production | Refrigerated Storage | | | | | |
|--|-----------------------|----------------------|----------------|----------------|----------------|-------------------------|----------------------|
| | | Short-term | | Medium-term | | Long-term | |
| | | Temperature °C | Weeks Expected | Temperature °C | Weeks Expected | Temperature °C | Weeks Expected |
| Oranges | | | | | | | |
| | USA (California) | | | | | +2 to +7 | 5 to 8 |
| | West Indies | | | | | +7 | |
| | Rep. of South Africa | | | | | +4,5 | 4 to 8 |
| Olinda Valencia (<i>Citrus sinensis</i> (L.) Osbeck) | Iran | | | | | +4 | 10 to 12 |
| Tarocco Blood (<i>Citrus sinensis</i> (L.) Osbeck) | Iran | | | | | +2 to +3 | 10 to 12 |
| Thomson Navel (<i>Citrus sinensis</i> (L.) Osbeck) | Iran | | | | | +4 | 10 to 14 |
| Mandarins | | | | | | | |
| | Australia | | | | | +7 | |
| | India | +15 to +18 | 2 | | | +5 to +7 | 3 to 6 |
| | | | 3 ^a | | | | 8 to 10 ^a |
| | Israel | +17 | 2 | | | +5 to +8 | 4 |
| Clementines | Morocco | +8 | 2 | +6 | 3 | +4 to +5 | 4 |
| | Spain | | | | | +4 to +5 | 4 to 6 |
| Clemnules | Spain | | | | | +4 to +5 | 4 to 6 |
| Satsuma | Spain | +10 to +12 | 1 to 2 | +6 to +8 | 3 | +4 | 8 |
| Page tangelo (<i>Citrus reticulata</i> var "Dancy" × <i>Citrus paradise</i> var "Duncan" × <i>Citrus clementina</i>) | Iran | | | | | +3 | 4 to 6 |
| Satsuma (<i>Citrus unshiy</i> Marcovich) | Iran | | | | | +1 to +3 | 4 to 6 |
| Lemons | | | | | | | |
| Green lemons | Rep. of South Africa | | | | | +11 | 12 to 16 |
| | Israel | +10 to +17 | 6 | +13 to +14 | 6 to 12 | +12 to +16 | 13 to 14 |
| | New Zealand | | | | | | 14 |
| | USA (California) | +12 to +13 | 3 | | | +12 to +13 0 to +5 | 13 to 20 3 to 6 |
| Coloured lemons | Israel | +8 to +17 | 4 | +10 to +14 | 4 to 6 | +13 to +14 | 6 to 8 |
| | New Zealand | | | | | | 10 to 14 |
| Grapefruits | | | | | | | |
| | Australia | | | | | +9 to +10,5 | |
| | Israel | +8 to +15 | 4 | +8 to +12 | 4 to 6 | +10 to +12 +8 to +10 | 6 to 12 10 |
| | India USA | | | | | +7 to +9 +10 to +15 | 12 4 to 12 |
| | Rep. of South Africa | | | | | +11 | 12 to 14 |
| Star ruby (<i>Citrus paradise Macfadyen</i>) | Iran | | | | | +8 | 12 to 16 |
| Red blush (<i>Citrus paradise Macfadyen</i>) | Iran | | | | | +8 | 12 to 16 |

Table 1 (Concluded)

| Cultivars | Country of Production | Refrigerated Storage | | | | | |
|--------------|-----------------------|----------------------|-------------------------------|----------------|----------------|------------------|------------------|
| | | Short-term | | Medium-term | | Long-term | |
| | | Temperature °C | Weeks Expected | Temperature °C | Weeks Expected | Temperature °C | Weeks Expected |
| Limes | | | | | | | |
| | USA (Florida) | | | | | +4 to +10 +10 | 3 to 8 3 to 4 |
| Yellow | India | +15 to +18 | 5 days 2 days ^a | | | +8 to +9 | 7 |
| Green | India | +15 to +18 | 5 days 2 days ^a | | | +8 to +9 | 8 |

^a Waxed fruits.

ANNEX A

(*Clause 3.1*)

(*Informative*)

LIST OF CULTIVARS AND THEIR SYNONYMS

A-1 ORANGES

A-1.1 Sub-group of “Navels”

- a) Washington Navel: Washington, Bahia Navel;
- b) Thomson Navel: Thompson Navel, Thomson, Thomsen's Navel, Navel Nice' and
- c) Leng Navel.

A-1.2 Sub-group of “Fine-blonds” (of Low Seeds Type)

- a) Shamouti;
- b) Cadenera: Cadena Fina, Cadena Sin Hueso, de la Cadena, Castellana, Cornice de la Cadena Fina, Précoce de Valence, Précoce des Canaries, Rharb, Espagne sans pépins, Valence sans pépins, de Valence;
- c) Maltaise blonde: Petite Jaffa;
- d) Hamlin;
- e) Vernia, Verna;
- f) Valencia late;
- g) Salustiana; and
- h) Mossambi/Sathgudi.

A-1.3 Sub-group of “Common-blonds” (Seeded)

- a) Marrs Early;
- b) Parson Brown; and
- c) Pineapple.

A-1.4 Sub-group of “Semi-blonds”

- a) Maltaise sanguine, Maltaise demi-sanguine, Portugaise, Portugaise sanguine, Portugaise demi-sanguine;
- b) Grosse sanguine or Double fine ameliorée: Sanguine ovale double fine, Washington sanguine;
- c) Double fine: Ovale de Sangre, Rojo oval, Ampollar, Sanguine ovale double fine, Double fine, Sanguine double fine; and
- d) Sanguinelli.

A-1.5 Sub-group of “Bloods”

- a) Moro;
- b) Tarocco; and
- c) Ruby blood.

A-2 MANDARINS

A-2.1 Sub-group of “True mandarins”

- a) Mandarin group: Mandarine d'Aigerie, Mandarine de Blidah, Mandarine de Boufarik, Mandarine de Bougie, Mandarine de Nice, Mandarine de Valence, Mandarine d'Australie, Mandarine Dupré, Mandarine de Paterne, Mandarine Avana, Mandarine Dai-Dai, Mandarine Ba Hamed, Mandarine Beladi, Mandarine Beledi, Mandarine Effendi, Mandarine Youssef Effendi, Mandarine Willow Leaf, Mandarine Willow-Leaved, Kino; and Kinnow mandarin.
- b) Oneco.

A-2.2 Sub-group of “King and Tangors”

- a) King of Siam: Mandarin King of Siam;
- b) Temple: Mandarin Temple;
- c) Murcott; and
- d) Ellendale Tangor.

A-2.3 Sub-group of “Satsumas”: unshiu

- a) Satsuma Wase; and
- b) Satsuma Owari.

A-2.4 Other Sub-group of “Mandarins”

- a) Clementine, Clemenules, Montreal;
- b) Wilking: Mandarin Wilking;
- c) Dancy: Dancy Tangerine;
- d) Robinson: Robinson Tangerine;
- e) Santra; and
- f) Som Keaw-arn.

A-3 LEMONS

A-3.1 Sub-group of “eureka”

- a) Eureka; and
- b) Villa Franca.

A-3.2 Sub-group of “Vernia”

- a) Vernia Berna.

A-3.3 Sub-group of “Everbearing”

- a) Quatre saisons; and
- b) P.S.P.: P.S.P. sans pépins.

A-3.4 Sub-group of “Probable Hybrids”

- a) Meyer.

A-3.5 Sub-group of “Lisbon”

- a) Lisbonne; and
- b) Sicilian, Bearss.

A-4 GRAPEFRUITS**A-4.1 Sub-group of “Blond Grapefruit”**

- a) Marsh seedless (seedless);
- b) Duncan (seeded); and
- c) Maccarty (seeded).

A-4.2 Sub-group of “Pink and Red Grapefruit”

- a) Foster (seeded);
- b) Thompson (seedless);
- c) Pink Marsh (seedless);

- d) Ruby Red (seedless); and
- e) Burgundy.

A-4.3 Sub-group of “Tangelos”

- a) San Jacinto;
- b) Sampson;
- c) Minneola;
- d) Orlando;
- e) Seminole;
- f) Wakiwa; and
- g) Nova.

A-5 TRUE LIMES

- a) West Indies Lime (Key lime): Lime Mexicaine, “Mexican lemon”, Citron Gallet, Kaghzi Nibbu.

A-6 LARGE-FRUITED LIMES

- a) Persian (Tahiti): Bearss.

ANNEX B*(Foreword)**(Informative)***LIST OF PRINCIPAL COMMERCIAL CULTIVARS AND PRODUCING COUNTRIES
(NON-RESTRICTIVE LIST)****B-1 ORANGES****B-1.1 Sub-group of “Navels”**

| Cultivar (Principal Designation) | Producing Countries |
|----------------------------------|--|
| Mossambi | India |
| Navel | Republic of South Africa, Algeria, Australia, Brazil |
| Navelate | Spain |
| Navelina | Spain |

B-1.2 Sub-group of “Fine-blonds” (of Low Seeds Type)

| Cultivar (Principal Designation) | Producing Countries |
|----------------------------------|---------------------------------------|
| Hamlin and various blonds | Algeria, Brazil, Greece, Morocco, USA |
| Ovale | Italy |
| Peira | Brazil |
| Salustiana | Spain, Morocco |

| Cultivar (Principal Designation) | Producing Countries |
|----------------------------------|--|
| Shamouti | Cyprus, Israel, Turkey |
| Tomango | Republic of South Africa |
| Valencia late | Republic of South Africa, Algeria, Australia, Brazil, Cyprus, Spain, Greece, Israel, Morocco, Tunisia, Turkey, USA |
| Vernia | Spain, Morocco |

B-1.3 Sub-group of “Common-blonds” (Seeded)

| Cultivar (Principal Designation) | Producing Countries |
|----------------------------------|--|
| Various | Spain, Italy, Greece, Republic of South Africa, USA (Florida, Texas) |
| Parson Brown | |
| Pineapple | |

B-1.4 Sub-group of “Semi-bloods”

| Cultivar (Principal Designation) | Producing Countries |
|-------------------------------------|--|
| Maltese | Algeria, Tunisia |
| Sanguinello | Spain, Italy, Morocco |
| Washington blood | Algeria, Morocco, Tunisia (improved double fine) |

B-1.5 Sub-group of “Bloods”

| Cultivar (Principal Designation) | Producing Countries |
|-------------------------------------|--|
| Moro | Italy |
| Ruby | USA, Algeria, Spain, Greece, Italy, Morocco |
| Common bloods | |
| Tarocco | Italy |
| Washington blood | Italy, Spain, Algeria, Morocco, Tunisia, USA |

B-2 MANDARINS

| Cultivar (Principal Designation) | Producing Countries |
|-------------------------------------|--|
| Santra | India |
| Kinnow mandarin | India |
| Satsuma | Spain, Japan, Turkey, Israel |
| Clementine | Algeria, Spain, Morocco, Tunisia, Israel |
| Monreal | Algeria, Spain, Morocco, Tunisia, Israel |
| Wilking | Morocco, Israel |
| Som Keaw-arn | Thailand |
| True Mandarins | Algeria, Spain, Greece, Italy, Israel, Japan, Tunisia, Turkey, USA |

B-3 LEMONS

| Cultivar (Principal Designation) | Producing Countries |
|----------------------------------|--|
| Eureka | Australia, Republic of South Africa, Israel, Morocco, USA, Spain |
| Vernia | Greece, Italy, Turkey |
| Interdonato | Greece, Italy, Turkey |
| Monachello | Spain, Israel, USA |
| Lisbon | |

B-5 GRAPEFRUITS AND HYBRIDS

| Cultivar (Principal Designation) | Producing Countries |
|-------------------------------------|--|
| Marsh Seedless | Spain, Israel, USA |
| Pink Marsh | USA |
| Various tangelos | Republic of South Africa, West Indies, USA |

B-6 LIMES

| Cultivar (Principal Designation) | Producing Countries |
|-------------------------------------|--------------------------|
| Kaghzi Nibbu | India |
| West Indian | West Indies, Mexico |
| Mexican | Near-East, Thailand, USA |
| Sweet Lime | Near-East |
| Tahiti (Persian) | USA (California, Texas) |

ANNEX C

(Clause 3.4)

(Informative)

DAMAGE IN STORAGE

C-1 GENERAL

There are many sources of damage to citrus fruits during storage. The most frequent of these are listed below.

C-2 FREEZING

Caused by accidental exposure to too-low temperatures, which in the case of certain citrus fruits may result in a bitter taste.

C-3 LOSS OF FLAVOUR

Unduly long storage may cause a loss of part of the flavour (aroma, taste) of the fruit.

C-4 PHYSIOLOGICAL CHANGES DUE TO TOO-LOW STORAGE TEMPERATURES

Very long exposure to too-low temperatures may result in:

- a) the appearance of brown surface marks on the skin known as "rind stain" (which can also be caused by insufficient ventilation); and
- b) the appearance of depressions in the skin known as "pitting".

C-5 OLEOCELLOSIS

Brown marks caused by the rupture of the essential oil-secreting cells. This rupture may be caused by rough handling of the turgid fruits and most particularly for early-season fruits.

C-6 FUNGAL DISEASES

These are caused mainly by infecting fungi penetrating the fruit through accidental wounds (such as those caused by pickers' fingernails, during handling operations or infection through the cut stems). They cause rotting that develops during storage. The most important of these diseases are:

- a) green mould caused by the fungus *Penicillium digitatum*;
- b) blue mould caused by the fungus *Penicillium italicum*;
- c) stem end-rot caused by the fungus *Phomopsis citri* (*Diaporthe citri*) and *Diplodia natalensis*;
- d) anthracnose caused by the fungus *Colletotrichum gloeosporioides*;
- e) brown rot caused by the fungus *Phytophthora citrophthora* and *Trichoderma viride*;
- f) black rot caused by the fungus *Alternaria citri* and other *Alternarias*; and
- g) sour rot caused by the fungus *Geotrichum candidum* = *Oospora citri-aurantii*.

Prevention of fungal rotting can be obtained by careful harvesting, fungicide treatments (provided they are not prohibited or limited by applicable regulations) to be carried out as soon as possible after harvesting, careful handling, disinfection of packing houses and storage rooms, quick cooling and storage and by the choice of a storage temperature as low as possible without causing damage due to cold.

C-7 BACTERIAL DISEASES

Damage may be caused by *Pseudomonas syringae* and other physiological diseases.

ANNEX D

(Foreword)

**CHANGES MADE IN THE STANDARD AFTER ADDITION/REPLACEMENT
OF THE TEXT IN ISO 3631 : 2019**

| Clause/Subclause of this Standard | Modifications from ISO |
|--|---|
| 1 Scope | In line 4, page 1, “Transport equipment” is replaced by “Transport vehicle or transport system”. Explanation: Railway cars, trucks or ships are transport vehicles and may not be considered as transport equipment. |
| 3.2 Harvesting | At a), line 3, page 1, “conditions and duration of storage” is replaced by “weather conditions and delayed harvesting”. Explanation: As the clause is related to maturity criteria, storage duration is not relevant to be considered. |
| 4.2.2 Pre-cooling | In line 3, page 2, “3 to 4 days” is replaced by “6 to 8 h”. Explanation: Precooling is the rapid removal of filled heat and bringing the fruit temperature to storage temperature within a short period of about 6 hours is required in a tropical country like India. |
| 4.2.2 Pre-cooling | At b), page 2, “air-circulation ratio: 100 to 200” is replaced by “air velocity : 200-400 mts/minute”. Explanation: Adequate air flow velocity is important for faster pre-cooling. |
| 4.3 Keeping life | In table 1, Column 7,page 3, Long term temperature (°C) for ‘Mossambi’, “+ 1 to + 2” is replaced by “+6 to +8” Explanation:The optimum temperature standardized for Mosambi is 6°C-8°C and below 4°C chilling injury is observed. Reference: Ladaniya, M.S. 2004. Standardization of temperature for long term refrigerated storage of ‘Mosambi’ sweet orange (<i>Citrus sinensis</i> Osbeck). <i>J. Food Sci. Tech.</i> 41: 692-695. |
| 4.3 Keeping life | In table 1, Column 7, page 5, Long term temperature (°C) for ‘Limes’, “+ 11 to + 13” is replaced by “+8 to +9” Explanation:The optimum temperature standardized for Limes is 8°C-9°C. Reference: Sudhakar Rao, D.V., and Ladaniya, M. S. (2015). Chapter 14. Citrus fruits. In: Managing postharvest quality and losses in horticultural crops Volume 2. Fruit Crops. Edited by K. L. Chadha and R. K. Pal. Published by Daya Publishing House, Astral International Pvt. Ltd., New Delhi, pp: 333-360. ISBN: 978-93-5124-356-4 (Vol. 2). |
| Annex A List of cultivars and their synonyms | In page 6, “Kinnow mandarin” cultivar has been added. |
| A.2.1 Sub-group of “true mandarins” | Explanation:Kinnow mandarin cultivar is one of the important cultivar of India which is missing in the list. |
| Annex B List of principal commercial cultivars and producing countries | In page 8, “Kinnow mandarin” has been added under the ‘cultivar’ and “India” has been added under ‘producing country’ for this cultivar. |
| B.2 Mandarins | Explanation:Kinnow mandarin cultivar is one of the important cultivar of India which is missing in the list. |

ANNEX E

(Foreword)

COMMITTEE COMPOSITION

Fruits, Vegetables, and Allied Products Sectional Committee, FAD 10

| <i>Organization</i> | <i>Representative(s)</i> |
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| All India Food Processors Association, New Delhi | DR R. K. BANSAL SHRIMATI MAMTA ARORA (<i>Alternate</i>) |
| Association of Food Scientists and Technologists India, Mumbai | DR REVATHY BASKARAN DR K. V. HARISH PRASHANTH (<i>Alternate</i>) |
| CSIR-Central Food Technological Research Institute, Mysore | DR P. VIJAYANAND DR A. S. CHAUHAN (<i>Alternate</i>) |
| College of Agricultural Engineering Post-Harvest Technology, Gangtok | DR SUJATA JENA DR SAID PRASHANT PANDHARINATH (<i>Alternate</i>) |
| Confederation of Indian Food Trade and Industry, New Delhi | SHRIMATI PRIYANKA SHARMA |
| Consumer Guidance Society of India, Mumbai | DR SITARAM DIXIT DR M. S. KAMATH (<i>Alternate</i>) |
| Dabur Research and Development Centre, Ghaziabad | SHRI DINESH C. PANDEY SHRI SUMIT NARA (<i>Alternate</i>) |
| Defence Food Research Laboratory, Mysore | DR O. P. CHOUHAN DR A. JAGANNATH (<i>Alternate</i>) |
| Export Inspection Council of India, New Delhi | SHRI PARMOD SIWACH |
| ICAR-Central Institute of Agricultural Engineering, Bhopal | DR C. R. MEHTA DR M. K. TRIPATHI (<i>Alternate</i>) |
| ICAR-Indian Institute of Horticultural Research, Bengaluru | DR R. B. TIWARI DR D. V. SUDHAKAR RAO (<i>Alternate</i>) |
| ICAR-Central Institute for Subtropical Horticulture, Lucknow | DR NEELIMA GARG |
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| ICAR-Central Plantation Crops Research Institute, Kasaragod | DR ANITHA KARUN DR M. R. MANIKANTAN (<i>Alternate</i>) |
| ITC Limited, Kolkata | SHRI KANNAN B. SHRI PRAKASH SELVARAJ (<i>Alternate</i>) |
| Indian Institute of Food Processing Technology, Thanjavur | DR V. R. SINIJA |
| Indian Institute of Packaging, Mumbai | DR TANWEER ALAM |
| Jain Irrigation Systems Limited, Jalgaon | SHRI SUNIL GUPTA SHRI VINAY JAIN (<i>Alternate</i>) |
| Mother Dairy Fruit and Vegetable Private Limited, Noida | SHRI KUMAR KALPAM NANCY TALWAR (<i>Alternate</i>) |

| <i>Organization</i> | <i>Representative(s)</i> |
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| National Institute of Food Technology Entrepreneurship and Management, Sonipat In Personal Capacity (<i>CD 223, Ansal Golf Link I, Greater Noida</i>) | DR SUNIL PAREEK SHRI PITAM CHANDRA |
| BIS Directorate General | SHRIMATI SUNEETI TOTEJA ,SCIENTIST 'E' AND HEAD (FAD) [REPRESENTING DIRECTOR GENERAL (<i>Ex-officio</i>)] |
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| SHRIMATI VARSHA GUPTA SCIENTIST 'D' (FAD), BIS | |

Panel Responsible for Review of Indian Standards Related to Storage, Transport and Ripening
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| Bhabha Atomic Research Centre, Mumbai | DR SATYENDRA GAUTAM |
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